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ABSTRACT

Reported is a study based on the assumptions that the attitude of elementary-age pupils toward the psychological object, science, affects cognitive learnings in science, that pupil's attitude toward science is affected by his teacher's attitude toward science, and that the teacher's attitude is affected by his knowledge of the subject. The study was done to assess the correlation of the two variables, science knowledge and science attitude of third year preservice elementary teachers. The population for this study was 92 third year elementary education majors enrolled in a science education course. The subjects had completed at least four university science courses. The Science From Concepts Achievement Test (SFCAT) was modified for use in assessing the science achievement level of the preservice teachers and the Science Attitude Scale for Preservice Elementary Teachers was used to measure the science attitude. The Pearson product-moment correlation coefficient was used to establish the relationship of the two variables. The correlation was low. The author stated that this study weakens the assumption that a teacher's cognition level in science affects his attitude toward the subject. He suggests that teacher educators should explore other variables in addition to that of science knowledge as a means of improving the attitude of preservice teachers toward science. (EB)

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The Correlation of Science Attitude and Science Knowledge of Preservice Elementary Teachers

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Introduction

One of the barriers to effective science teaching, as revealed by Blackwood (1964) in his nationwide survey of elementary teachers and principals, was a lack of teacher interest in science. Of 17 percepts developed by Stollberg (1969) on the subject of professionalizing science education for the elementary teacher, he rates the personal attitude of the teacher toward science as sine qua non. Furthermore, Stollberg writes that teachers who have a negative or neutral attitude toward science can pass on this attitude to young children.

Hone and Carswell (1969) support Stollberg with the statement: "Children's built-in radar is fine-tuned to their teacher's feelings about science." (p. 24) Hone and Carswell consider an attitude change on the part of elementary school teachers toward science as the primary goal of in-service science education.

Washton's (1971) study indicated that pupils imitate the attitude of their elementary teachers toward science. In a report of his study of 100 New York teachers, Washton concluded: "They felt that their elementary school teachers disliked science and so it was contagious to dislike science. As a result, they were afraid to teach science to their pupils." (p. 378)

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Assuming that science is an enterprise toward which our society can ill afford less than a positive attitude, there is need to explore the variables in the preparation of elementary teachers that might have some bearing on their attitude toward science.

Relationship of Knowledge and Attitude

One of the important components of teacher preparation is the knowledge of science content. Teacher preparation programs for elementary teachers require that the education student complete several science content courses. One of the nine guidelines in the preparation of elementary school teachers as established by the National Association of State Directors of Teacher Education and Certification (NASDTEC) (1963) spells out the preparation needed by elementary teachers in earth, space, biological and physical sciences.

The acquisition of science content must fill more than a cognitive need in the professional life of an elementary teacher. A pool of science content, especially the understanding of science concepts that function as a part of the environment of the young child they plan to teach, is motivating to a beginning teacher and thus has a positive attitudinal effect.

Washton's (1971) study confirms the assumption that science knowledge has a positive effect on the teacher's affective domain of learning. He writes: "Getting higher scores on standardized science tests will reduce fears. Self-achievement is an effective weapon against negative attitudes or fears of teaching science. (p. 378).

Assumptions of the Study

This study was based on several assumptions. (1) The attitude of elementary-age pupils toward the psychological object, science, affects their cognitive learnings in the subject. (2) The pupil's attitude toward science is affected by his teacher's attitude toward science. (3) The attitude of the teacher toward science is affected by the teacher's knowledge of the subject.

If a higher cognition level in science affects a teacher's attitude positively, there should be a high positive correlation between science knowledge and science attitude of the population investigated in this study. Furthermore, a high positive correlation between knowledge and attitude scores of the subjects in this study could indicate that science knowledge may be one of the important variables affecting the attitude of preservice elementary teachers toward science. Such a finding could mean that teachers colleges could predict, as well as improve by design, the attitude of teachers toward science by proper manipulation of the variable, science knowledge.

Problem

The purpose of this study was to assess the correlation of two variables, science knowledge (I) and science attitude (II) of third year preservice elementary teachers.

Definitions

Science attitude was defined in this study as the feelings of preservice teachers toward science and the teaching of science as measured by the Shrigley's (1971) instrument.

Science knowledge was defined as the understanding preservice teachers have of science concepts taught in the elementary school as measured by

Christman's (1970) instrument. The instrument was designed to measure comprehension and application of science concepts more than the recall of science facts.

Population

The population for this study was 92 third year elementary education majors enrolled in a science education course at The Pennsylvania State University during the Fall Term of 1972. The subjects had completed at least four university science content courses.

Development of the Instruments

Science From Concepts Achievement Test (SFCAT). Christman (1970) designed a 64 item multiple choice instrument to assess the science achievement level of preservice elementary teachers. Content validity was established by a panel of three experts who surveyed four elementary science textbook series and one experimental elementary science curriculum project and listed the science concepts common to all sources. The test items were developed to represent primarily the higher levels of learning on Bloom's (1956) taxonomy.

The original SFCAT consisted of 102 items. An item analysis of the instrument was made after each of the four administrations to elementary education majors. Each time items were modified or deleted on the basis of their discrimination and difficulty index. The final draft of 64 items had a K-R of .72 and mean item difficulty of .57.

Christman's instrument was modified for this study. After administering the SFCAT again to preservice elementary teachers, an item analysis was made by the investigator and an expert in the sciences. As a result of this analysis, one question was dropped and several items were reworded. An item analysis was administered on the data gathered during the investigation.

The K-R 20 was .76, mean difficulty was .54, the test mean was 33.90, the test range was 34, the standard deviation was 7.04 and the standard error of measurement was 3.42.

A representative sampling the five of the 63 items on the revised Christman SFCAT is listed below:

1. If a child is searching for fossils, he is most likely to find them in

   A. metamorphic rocks.
   B. igneous rocks.
   *C. marine sedimentary rocks.
   D. glacial deposits.

2. In order to germinate, seeds must have

   A. sunshine.
   B. chlorophyll.
   *C. water.
   D. all of the above.

3.

Caterpillar Earthworm Ant Spider

Of the above organisms

   A. A and B are most closely related.
   B. C and D are most closely related.
   *C. A and C are most closely related.
   D. B and D are most closely related.

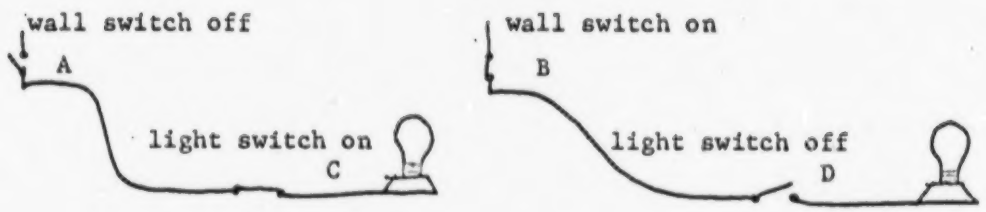
4. Which of these is the correct position of the sun, moon, and earth in a solar eclipse? (Diagram not drawn to scale).

A. S E M

*B. S M E

C. E S M

D. M S E

5. 

The light bulbs are out. By cutting through the wire insulation with metal clippers you could possibly get a shock at

A.
*B.
C.
D.

Science Attitude Scale for Preservice Elementary Teachers. Shrigley (1971) developed a Likert-type attitude scale to measure the science attitude of pre-service elementary teachers. Attitude statements toward the subject of science, the teaching of science and the handling of science equipment were gleaned for comments made voluntarily by preservice elementary teachers. Using the guidelines provided by Edwards (1957), 38 positive and negative statements were administered to 89 undergraduate students enrolled in a science education course for elementary majors. The respondents were asked to respond anonymously to each statement with one of five options: "strongly agree," "agree," "undecided," "disagree," or "strongly disagree."

The Likert Scale Analysis (Kohr, 1968) computer program at The Pennsylvania State University was used to analyze the responses made to the attitude statements. The raw scores of respondents in the upper and lower 27 per cent became criterion groups whereby the favorable-unfavorable index of each statement could be established. The t-score (for difference between means of the low and high total attitude groups) on the original 38 statements ranged from 0.9 to 9.5. The reliability (coefficient alpha) for the total attitude scale was .91.

With minimum of 25 respondents in each criterion group, Edwards (1957) suggested a minimum t-score of 1.75 as a rule of thunb for selection of statements. In this study there were 24 respondents in each group (27% or 89 respondents). The investigator chose a t-score of 3.8 as the point at which statements were dropped from the scale. The responses made by the pilot group of 89 students were then re-submitted to the Likert analysis. The t-score on the 23 statements of revised scale ranged from 3.4 to 9.6 and the reliability was .92.

Shrigley Science Attitude Scale for Preservice Elementary Teachers

Directions: This is not a test. You are to indicate your feelings toward the subject of science and science teaching. You may react to the statements in one of five ways on the answer sheet:

A - Strongly Agree
B - Agree
C - Undecided
D - Disagree
E - Strongly Disagree

Do not place your name on the answer sheet.

1. I daydream during science classes. (Neg.) *
2. I would like to have chosen science as a minor in my elementary education program. (Pos.)
3. I dread science classes. (Neg.)
4. Science equipment confuses me. (Neg.)
5. Science is not an important subject in the elementary curriculum. (Neg.)
6. I enjoy manipulating science equipment. (Pos.)
7. I am afraid that young pupils will ask me science questions that I cannot answer. (Neg.)
8. In science classes, I enjoyed lab periods. (Pos.)
9. Science is my favorite subject. (Pos.)
10. If given the choice in student teaching, I would prefer teaching science over any other subject in the elementary school. (Pos.)
11. My science classes have been boring. (Neg.)
12. I would enjoy helping children construct science equipment. (Pos.)
13. When I become a teacher, I fear that the science demonstrations will not work in class. (Neg.)
14. I am looking forward to teaching science to elementary children. (Pos.)
15. I enjoy college science courses. (Pos.)
16. I prefer that the instructor of a science class demonstrate equipment instead of expecting me to manipulate it. (Neg.)
17. I would be interested in working in an experimental elementary science curriculum project. (Pos.)
18. I enjoy discussing science topics with my friends. (Pos.)
19. Science is very difficult for me to understand. (Neg.)
20. I expect to be able to excite students about science. (Pos.)
21. I frequently use scientific ideas or facts in my personal life. (Pos.)
22. Pre-supposing adequate knowledge about science, I would enjoy teaching the subject to children. (Pos.)
23. I believe that I have the same scientific curiosity as children. (Pos.)

* The only modification of the scale is the classification of each statement as "positive" or "negative." This is done for the benefit of anyone wishing to use the scale.

Procedure

Early in the ten week term, the two instruments, Christman's Science From Concepts Achievement Test and Shrigley's Science Attitude Scale for Preservice Elementary Teachers, were administered to the subjects in the study. The last four digits of each respondent's social security number was used as a means of identifying answer sheets so that scores from the two instruments could be paired and properly scored. The Pearson product-moment correlation coefficient was the test used to establish the relationship of the two variables.

Results of the Study

The mean score for Variable I, science knowledge, was 32.34 and the standard deviation was 6.98. The mean score for Variable II, science attitude, was 73.72 and the standard deviation was 13.39. When the pairs of measurement were compared by the Pearson product-moment correlation coefficient, the r was .25. The correlation coefficient between the two variables is low. Guilford (1956) rates correlations of .20 to .40 as low, definite, but small relationship. Where r = .25 only six per cent of the variance of Variable II, science attitude, can be predicted by Variable I, science knowledge. This means that 94 per cent of the variance can be attributed to other variables.

Interpretation of the Data

First of all, this study tends to refute Washton's (1971) study which implied a relationship between science attitude and knowledge. However, the investigations differed in purpose and procedure. Washton's study implied that self-achievement in science affected the attitude of 100 in-service teachers.

With a low positive correlation between science knowledge and attitude on the part of preservice elementary teachers, this study weakens the assumption that a teacher's cognition level in science affects his attitude toward the subject.

Futhermore, these data imply that preservice teachers with higher test scores on science achievement tests will not necessarily have a more positive attitude toward science than teachers with lower scores. This study implies that enrolling preservice elementary teachers in more college science courses will not necessarily result in a more positive attitude toward science.

Selecting as team leaders in science teachers with a strong background in science content may not necessarily result in selecting leaders who are more positive in their attitude toward science.

Recommendations for Further Study

The results of this study indicate that teacher educators should explore other variables in addition to science knowledge as a means of improving the attitude of preservice teachers toward science.

Redesigned Science Courses. Instead of more semester hours of science, we may need to redesign the science learnings experiences for preservice elementary teachers. The college science courses taken by most of the subjects in this study were taught in a conventional manner. The courses were general survey courses taught in large lecture sessions, some without any laboratory experiences. The investigator recommends that the rationale undergirding the innovative science programs for elementary school pupils (ESS, SAPA, SCIS) be considered as a model for college science courses for teachers.

If we can assume that direct involvement of children in such processes as observation, inference and manipulation of variables motivate them to enjoy science, there is reason to assume that the attitude of adults might be likewise affected.

If manipulative, hands-on experiences with scientific phenomena is stimulating for children why could we not assume that open ended, small group, laboratory experiences in college science courses would provide affective science learnings for teachers?

Courses with such goals in mind have been designed at The Pennsylvania State University. Although there is as yet no empirical evidence that much courses improve the science attitude of preservice teachers, the reaction of the small sampling of students who have completed one or more of the courses is encouraging.

Role-playing. On the other hand, teacher educators may need to look to the field of social psychology for an attitude paradigm used by social scientists that would be compatible with practives in the field of education. The effect of role playing an attitude change is discussed by Zimbardo and Ebbesen (1969). Playing a role contrary to one's attitude provides insight that can serve to modify that attitude. If pre-service teachers with a negative attitude toward science could be identified, they could be directed to play a positive role during classroom discussion and debate. Thus a change in attitude might be realized.

The role playing paradigm might not be limited to a verbal role. The investigator has involved teacher trainees in a type of role playing whereby they experience firsthand science lessons similar to those of elementary school children. Empirical studies should be developed to assess the effect this type of role playing has on the science attitude of preservice teachers.

Credibility of the Teacher Educator. An attitude paradigm might be built on another theory common to social psychology, the credibility of the communicator. Halloran (1970, p. 61) claims that attitude change is affected by "....the degree to which the communicator is perceived as being expert, fair and trustworthy...."

Placed within the spectrum of education, this paradigm would place special focus on the teacher educator selected to prepare teachers. What relationship between the teacher educator and science teaching in the elementary classroom would be considered credible by teacher trainees?

In an initial probe into this question, the investigator has discovered that teacher trainees have some rather definite criteria that goes to make up instructor credibility. Ninety-one per cent of a group of elementary education majors surveyed in four midwest colleges and universities agreed that instructors of elementary science education courses should have taught in the elementary schools for several years. On the other hand, only 14 per cent of the same sample agreed that the instructor should be involved in writing science textbooks for children. Empirical evidence is needed to determine if instructor credibility is a variable worthy of exploration in science attitude research.

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